LunarCube for Deep Space Missions, Phase II

Completed Technology Project (2015 - 2021)

Project Introduction

Busek, in partnership with Morehead State University (MSU), proposes to develop a versatile 6U CubeSat capable of reaching a lunar orbit from GEO. The primary objective of the Phase II effort is to demonstrate a complete, mini ion propulsion system that provides ~3000sec Isp heretofore unavailable to CubeSats, with a solid-storable iodine propellant. This type of propulsion technology would be a huge mission enabler and ideal for volume-limited satellites such as CubeSats. The 6U bus, combined with ion propulsion, has already shown being highly attractive to science payload developers targeting the upcoming SLS/EM-1 lunar mission. During Phase I Busek successfully demonstrated the world's first iodine-fueled gridded ion thruster "BIT-3". Key performance characteristics of BIT-3 include a compact design envelope (2.8km/s delta-V to a 6U/12kg CubeSat. The ultimate goal of the LunarCube program is to undertake a mission to the Moon from GEO or a translunar trajectory (such as the EM-1 drop-off) that would demonstrate the propulsion system, and carry out a lunar science program as a capability demonstration of the platform. During this mission, a related goal is to demonstrate that much of the spacecraft's miniature electronics, primarily C&DH, communications, and the propulsion system's PPU can be based on low cost components and survive the harsh deep-space environment.

Anticipated Benefits

The high-Isp ion propulsion, in addition to the low-cost radiation tolerant electronics needed for the lunar mission, is crucial for future deep space missions. Exploring our solar system with low-cost robotic/scout vehicles as precursors for human missions or science missions will benefit from these technologies. Busek's revolutionary iodine RF ion thruster enables small satellites to fly beyond earth orbit and can be used in close proximity operations. Potential NASA applications include missions to the moon (such as the upcoming EM-1 mission), inner planets and asteroids. Additionally, this mini ion propulsion system is ideal for drag make-up applications for earth observation (EO) missions from low flying platforms, down to altitudes of ~200km. Altitude reduction is essential for high resolution EO from small, low-cost satellites that are by definition unsuitable for large optical or RF apertures and thus lower altitude is the only option for higher image resolution. Potential post applications of MSU's multi-band communications systems include productization and marketing to the small satellite community for a variety of applications in LEO and beyond. The capabilities and flexibility of this system (software controlled frequency agility and controllable, variable power output combined with a variety of modulation schemes) combined with an extremely low price point will make the system attractive to small satellite developers supported by NASA.The market size for the LunarCube's iodine ion propulsion system is very large. Potential non-NASA customers include commercial human exploration and presence in space, commercial asteroid missions, DoD and commercial EO missions. Busek has already received significant interest

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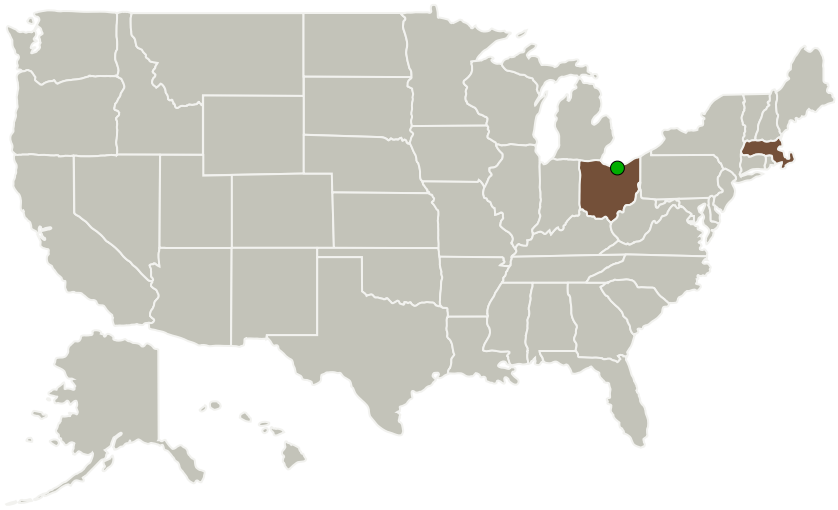
from science and commercial missions including lunar exploration, asteroid prospecting, etc. NRO has also indicated interest in this propulsion technology for stationkeeping LEO spacecraft. MSU's LunarCube C&DH system will also be ultimately produced for both the small satellite and UAV markets. The small size, low power consumption and significant processing capabilities combined with low cost and expandability, will make this C&DH system competitive in these markets.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Busek Company, Inc.	Lead Organization	Industry Women-Owned Small Business (WOSB)	Natick, Massachusetts
Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations	
Massachusetts	Ohio

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Busek Company, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Project Managers:

Wensheng Huang
Matthew C Deans

Principal Investigator:

Michael Tsay

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Project Transitions

September 2015: Project Start

October 2020: Closed out

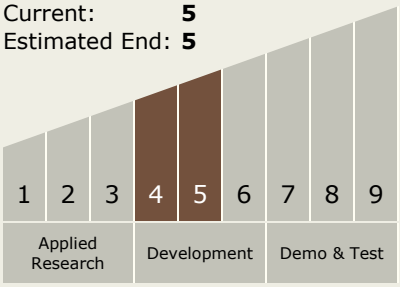
Closeout Documentation:
- Final Summary Chart*(https://techport.nasa.gov/file/139070)*

March 2021: Closed out

Closeout Documentation:
- Final Summary Chart PDF*(https://techport.nasa.gov/file/139069)*

Technology Maturity (TRL)

Start: **4**
Current: **5**
Estimated End: **5**



Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System